

# **Accuracy Characteristics for ZID Risk Reduction Scenario Hours 2100-2300**

## **1 Introduction**

This document contains scenario characteristics for hours 2100 to 2300 GMT recorded on October 11, 2000 at Indianapolis ARTCC (ZID). Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, and flight plan adherence. Definitions of the provided scenario characteristics are provided in Reference[1].

## **2 Reference**

[1] Paglione,M., Oaks,R., Ryan,Dr. H., Summerill,J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

## **3 Center Airspace**

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZID Center using the October 5, 2000 ACES chart cycle. Information provided in Table 1 was gathered from running URET PRE and local knowledge.

**Table 1: Center Airspace Characteristics**

Metric	Definitions	Count
Airports	From URET DU Adaptation List	508
Sectors	From URET DU Adaptation List	113
SAA	Special Activities Airspace	15
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	13
STAR	Standard Arrival Route	90
PAR	Preferential Arrival Route	273
PDR	Preferential Departure Route	273
PDAR	Preferential Departure Arrival Route	179

## 4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

### 4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

**Table 2: Count of Current Plan Aircraft Encounters**

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	165	97
$5 \leq d < 10$	202	122
$10 \leq d < 15$	307	187
$15 \leq d < 23$	693	359
$23 \leq d < 30$	525	280
Total	1892	1045

**Table 3: Count of Trial Plan Aircraft Encounters**

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	165	95
$5 \leq d < 10$	202	117
$10 \leq d < 15$	307	180
$15 \leq d < 24$	784	393
$24 \leq d < 30$	434	220
Total	1892	1005

## 4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

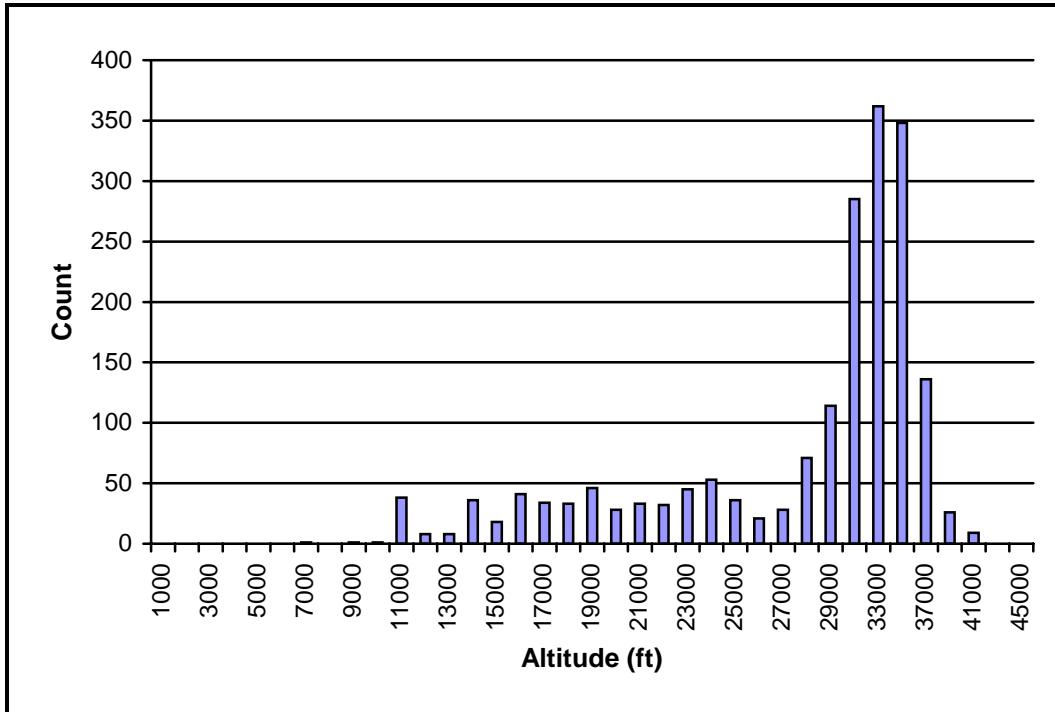


Figure 1: Aircraft to Aircraft Encounters by Altitude

## 4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 4: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	110	78	74	38	300
Descend-Descend	52	13	8	15	88
Climb-Climb	70	21	23	26	140
Cruise-Climb	220	145	103	111	579
Cruise-Descend	149	110	113	160	532
Climb-Descend	74	47	30	62	213
Unknown	24	5	4	7	40
Total	699	419	355	419	1892

## 5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

### 5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

**Table 5: Count of Current Plan Airspace Encounters by Horizontal Separation**

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts <sup>1</sup>	115	80
$d = 0^2$	6	5
$0 < d < 7$	177	130
$7 \leq d < 9$	48	36
$9 \leq d < 11$	68	52
$11 \leq d < 16$	126	88
$16 \leq d < 30$	369	281
Total	909	672

**Table 6: Count of Trial Plan Airspace Encounters by Horizontal Separation**

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts <sup>3</sup>	115	79
$d = 0^4$	6	5
$0 < d < 8$	205	150
$8 \leq d < 11$	88	67
$11 \leq d < 13$	51	32
$13 \leq d < 19$	162	112
$19 \leq d < 30$	282	217
Total	909	662

<sup>1</sup> This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

<sup>2</sup> This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

<sup>3</sup> This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

<sup>4</sup> This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

## 5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

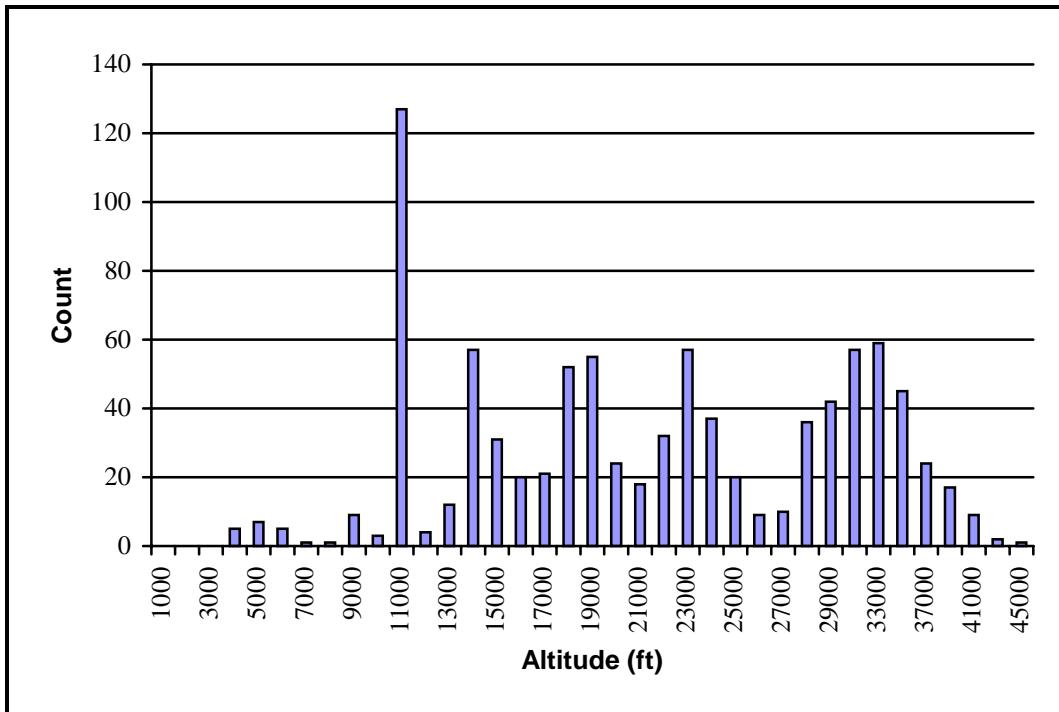


Figure 2: Airspace to Airspace Encounters by Altitude

### 5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

**Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts**

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	3	9	6	18
Cruise	4	15	31	50
Descend	1	4	4	9
Total	8	28	41	77

**Table 8: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts**

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	3	0	0	3
Cruise	0	0	0	0
Descend	11	0	0	11
Total	14	0	0	14

**Table 9: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles**

Vertical Phase	Count
Climb	20
Cruise	3
Descend	1
Total	24

## 6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

### 6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

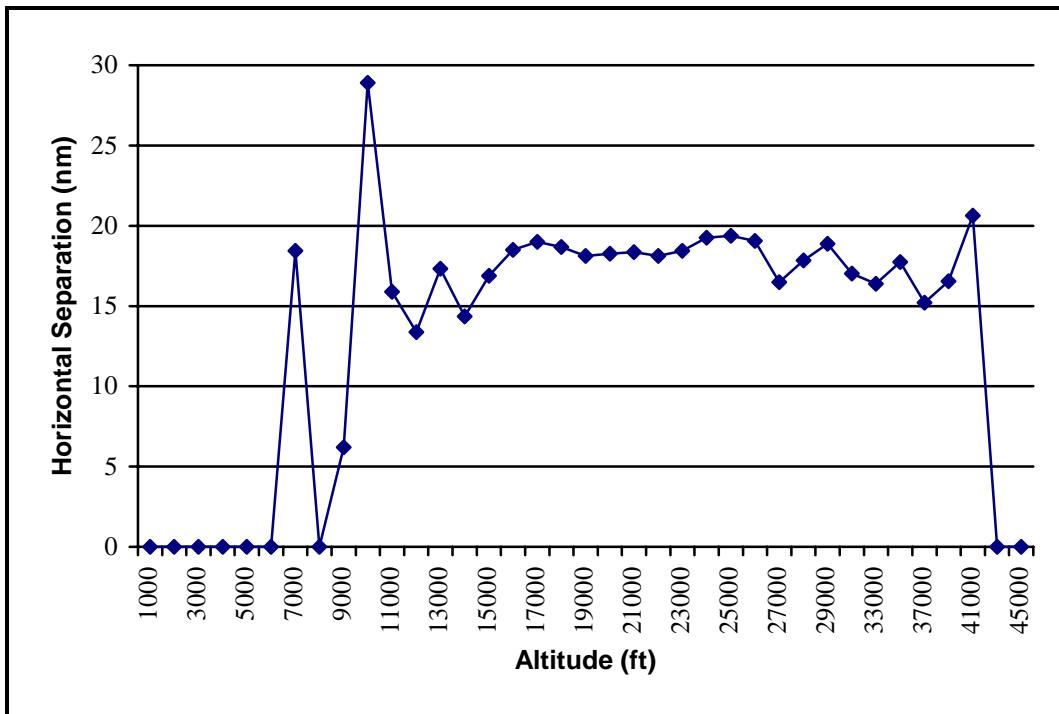


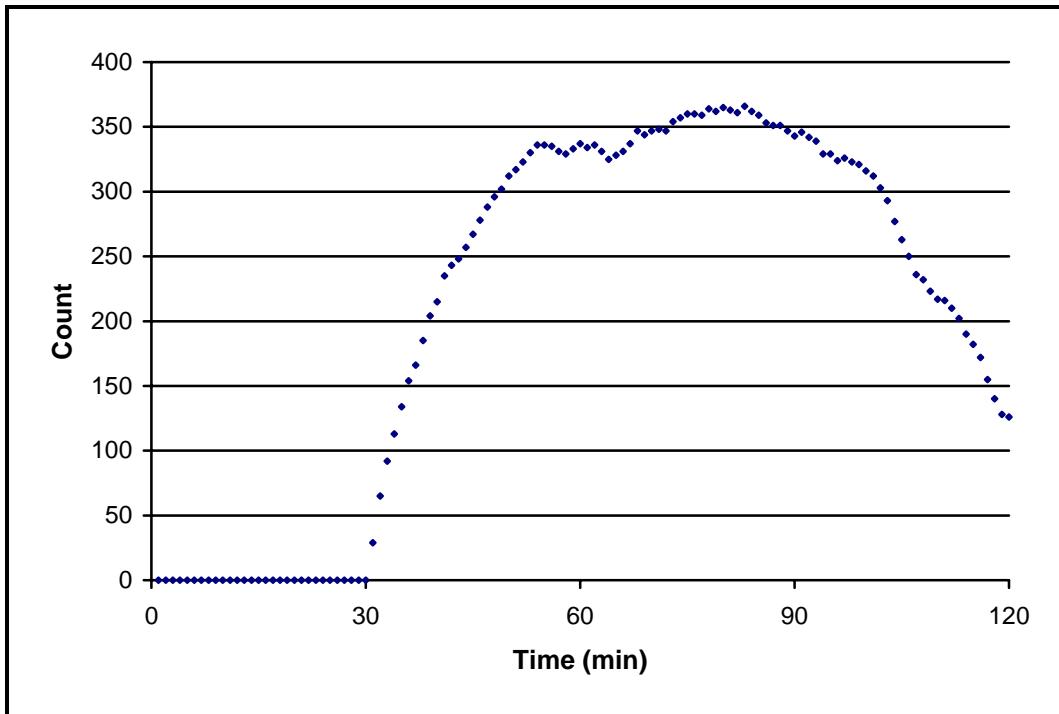
Figure 3: Average Horizontal Separation by Altitude for All Hours

## 6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

**Table 10: Statistics on Active Flights per Minute Increment**

Count Average	Standard Deviation	Maximum Count	Minimum Count
212.533	141.922	366	0



**Figure 4: Count of Active Flights per Minute Increment**

### 6.3 Flight Type and Sector Penetration

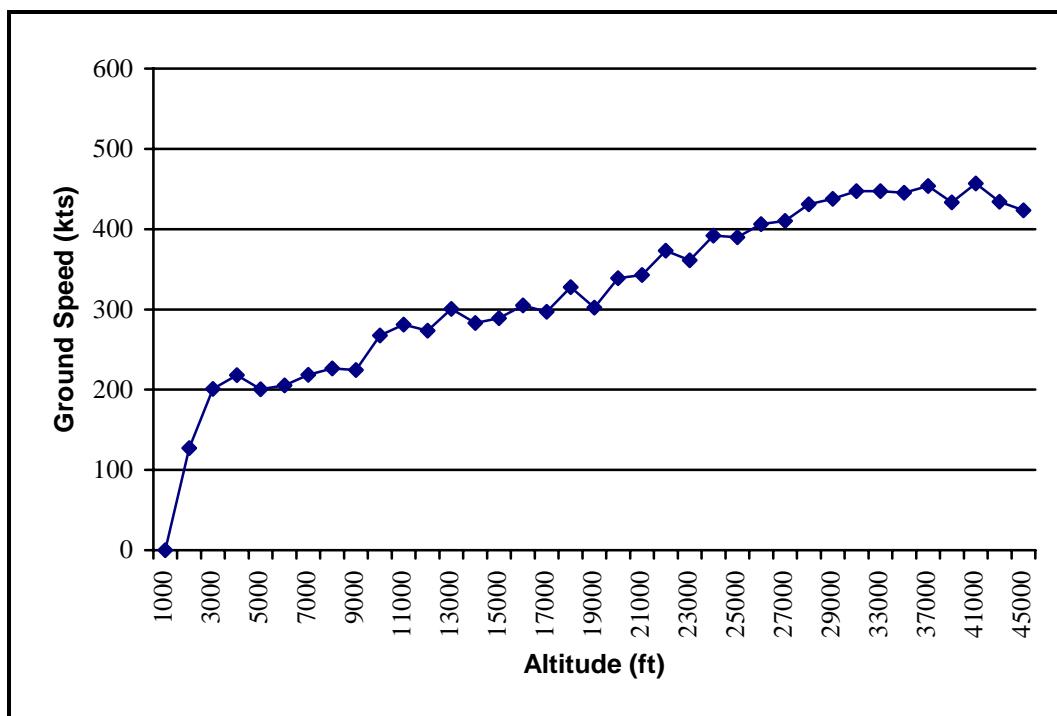
This section corresponds to Section 3.3.3 of Reference[1].

**Table 11: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type**

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	2.553	2.838	2.588	2.346	2.610
Average Time in Center (sec)	1252.944	1376.034	1158.468	1403.704	1253.346
Average Time in Sector (sec)	483.161	477.008	437.729	588.526	471.277
Percentage by Flight Type	24.142	21.936	43.995	9.926	100.000

### 6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.



**Figure 5: Average Ground Speed by Altitude for All Hours**

## 6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

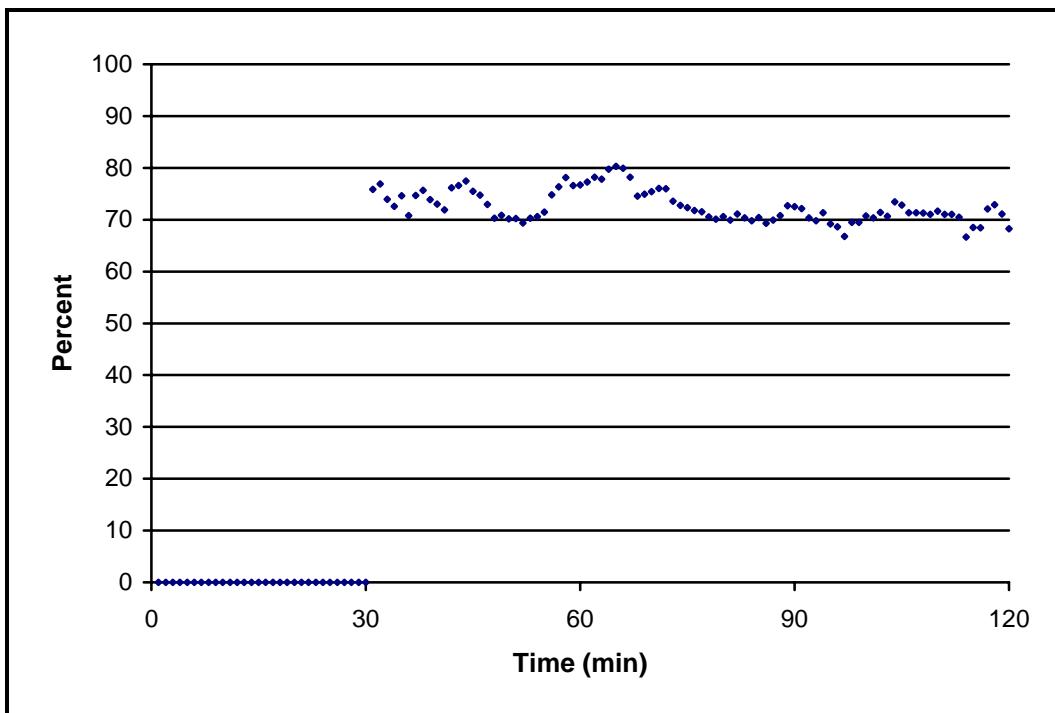


Figure 6: Percentage of Track Points in Center to APD Zone per Minute Increment

## 6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 12: Statistics on Interim Altitude Messages<sup>5</sup>

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
616	2.987	1.171	7	1

## 6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 13: Statistics on Amendment Messages per Flight<sup>6</sup>

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
416	2.476	1.629	9	1

<sup>5</sup> Statistics on flights with interim altitude messages only

<sup>6</sup> Statistics on flights with flight plan amendments only

## 6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

**Table 14: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight**

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	4519	1077	5596
DES	5167	953	6120
LEV	1797	984	2781
Total	11483	3014	14497

**Table 15: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase**

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	31.172	7.429	38.601
DES	35.642	6.574	42.216
LEV	12.396	6.788	19.183
Margin (%)	79.209	20.791	100.000

## 7 Aircraft Distributions

This sections provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

### 7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

**Table 16: Count by Aircraft Type**

Aircraft Type	Count	Percentage of Total
J	670	81.409
P	38	4.617
T	114	13.852
Unknown	1	0.122
Total	823	100.000

## 7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

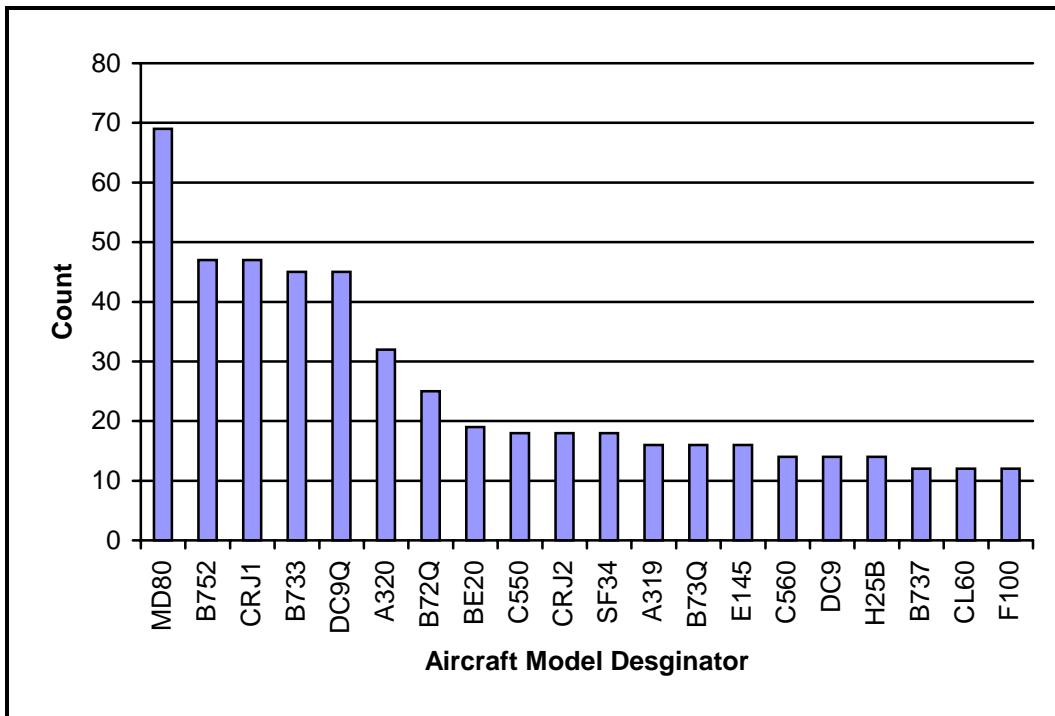


Figure 7: Count of Top Twenty Aircraft Models

### **7.3 Navigational Equipage**

This section corresponds to Section 3.4.3 of Reference[1].

**Table 17: Count by Aircraft Navigational Equipage Type**

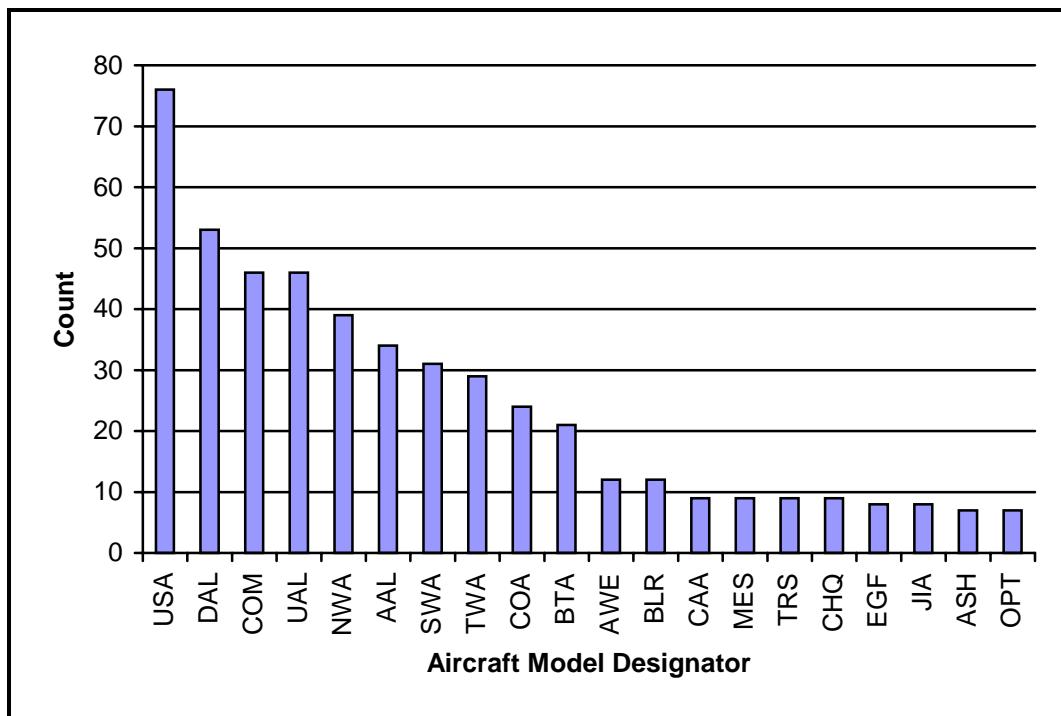
Nav. Equip. Designator	Count	Percentage of total
A	183	22.236
G	162	19.684
E	156	18.955
F	152	18.469
I	134	16.282
R	21	2.552
Q	10	1.215
W	3	0.365
U	2	0.243
Total	823	100.000

## 7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

**Table 18: Count by Carrier Type**

Category	Count	Percentage of Total
Commercial	608	73.876
General Aviation	205	24.909
Other <sup>7</sup>	10	1.215
Total	823	100.000



**Figure 8: Count by Top Twenty Air Carriers**

<sup>7</sup> Includes military and aircraft with unrecognized designators

## 8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

### 8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

**Table 19: Statistics on Lateral Flight Plan Adherence by Altitude<sup>8</sup>**

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	15	22.144	11.104	15.322	2.770
18000	11	29.420	13.143	17.355	2.901
33000	44	48.017	13.080	26.228	6.177
45000	20	67.608	19.019	26.810	8.080
Total	90				

### 8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

**Table 20: Statistics on Vertical Flight Plan Adherence by Altitude<sup>9</sup>**

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	377	32100	316	5355.997	4349.641
45000	204	10000	567	3509.852	1964.255
Total	581				

<sup>8</sup> Statistics determined on tracks out of lateral adherence only.

<sup>9</sup> Statistics were determined on tracks out of vertical adherence only.

## Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

**Table 21: Statistics on Aircraft Encounters by Altitude Interval for All Hours**

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	0	0.000	0.000
5000	0	0.000	0.000
6000	0	0.000	0.000
7000	1	18.433	0.000
8000	0	0.000	0.000
9000	1	6.209	0.000
10000	1	28.902	0.000
11000	38	15.889	8.390
12000	8	13.376	8.513
13000	8	17.331	6.461
14000	36	14.353	8.965
15000	18	16.888	6.715
16000	41	18.502	5.428
17000	34	18.994	7.576
18000	33	18.668	7.541
19000	46	18.120	6.406
20000	28	18.266	7.722
21000	33	18.357	7.546
22000	32	18.124	8.306
23000	45	18.442	6.595
24000	53	19.264	6.412
25000	36	19.382	7.180
26000	21	19.051	6.180
27000	28	16.477	8.642
28000	71	17.850	6.278
29000	114	18.870	7.110
31000	285	17.021	7.757
33000	362	16.389	7.806
35000	348	17.735	7.702
37000	136	15.209	8.347
39000	26	16.535	7.255
41000	9	20.630	7.157
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	1892		

## Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

**Table 22: Statistics on Ground Speed by Altitude for All Hours**

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	0	0.00	0.00
2000	11	127.27	35.21
3000	31	201.03	41.69
4000	91	218.13	43.88
5000	155	200.34	44.01
6000	219	205.32	51.10
7000	256	218.65	51.71
8000	302	226.41	49.99
9000	322	224.30	58.44
10000	337	267.37	68.83
11000	351	280.98	80.91
12000	351	273.54	75.86
13000	347	300.72	62.75
14000	351	282.94	77.13
15000	358	289.06	73.13
16000	357	305.02	65.71
17000	357	296.83	73.87
18000	360	327.66	69.54
19000	365	302.19	75.61
20000	356	338.78	76.18
21000	362	342.86	83.74
22000	361	373.03	71.81
23000	353	361.27	74.01
24000	352	391.79	71.49
25000	340	389.94	70.95
26000	341	406.24	66.96
27000	336	410.41	69.52
28000	343	430.87	44.50
29000	336	437.69	47.37
31000	332	447.15	33.56
33000	306	447.25	34.53
35000	247	445.25	27.04
37000	155	453.69	33.54
39000	69	433.53	36.23
41000	33	456.71	32.81
43000	13	434.26	28.39
45000	5	423.40	35.73

## Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

**Table 23: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight**

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	0	0
	DES	0	0
	LEV	0	0
2000	ASC	3	5
	DES	1	0
	LEV	5	9
3000	ASC	10	14
	DES	5	7
	LEV	13	22
4000	ASC	16	18
	DES	40	26
	LEV	31	28
5000	ASC	26	21
	DES	61	65
	LEV	53	41
6000	ASC	37	29
	DES	88	80
	LEV	74	42
7000	ASC	27	24
	DES	103	80
	LEV	108	51
8000	ASC	28	22
	DES	131	96
	LEV	127	44
9000	ASC	25	24
	DES	131	90
	LEV	146	50
10000	ASC	52	29
	DES	146	57
	LEV	166	51
11000	ASC	84	39
	DES	172	47
	LEV	185	51
12000	ASC	26	13
	DES	170	29
	LEV	188	36

13000	ASC	13	8
	DES	162	31
	LEV	193	27
14000	ASC	19	11
	DES	173	27
	LEV	199	22
15000	ASC	30	17
	DES	167	27
	LEV	204	26
16000	ASC	30	14
	DES	173	29
	LEV	200	28
17000	ASC	31	19
	DES	175	26
	LEV	203	26
18000	ASC	37	21
	DES	177	29
	LEV	200	30
19000	ASC	35	21
	DES	182	32
	LEV	203	38
20000	ASC	32	14
	DES	180	23
	LEV	203	32
21000	ASC	30	21
	DES	176	18
	LEV	212	25
22000	ASC	45	25
	DES	172	22
	LEV	221	28
23000	ASC	40	16
	DES	168	11
	LEV	213	32
24000	ASC	76	22
	DES	174	22
	LEV	211	30
25000	ASC	34	14
	DES	168	21
	LEV	209	21
26000	ASC	36	14
	DES	171	14

	LEV	209	16
27000	ASC	43	12
	DES	174	14
	LEV	211	12
28000	ASC	103	27
	DES	175	22
	LEV	211	16
29000	ASC	123	46
	DES	173	21
	LEV	196	16
31000	ASC	160	78
	DES	170	32
	LEV	181	31
33000	ASC	185	113
	DES	153	36
	LEV	150	40
35000	ASC	164	105
	DES	109	26
	LEV	114	16
37000	ASC	108	73
	DES	50	5
	LEV	74	9
39000	ASC	48	29
	DES	29	8
	LEV	31	6
41000	ASC	25	15
	DES	11	3
	LEV	17	1
43000	ASC	11	11
	DES	5	1
	LEV	5	0
45000	ASC	5	0
	DES	4	0
	LEV	1	0

## Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 24: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	69	5.711
B752	47	5.711
CRJ1	47	5.468
B733	45	5.468
DC9Q	45	3.888
A320	32	3.038
B72Q	25	2.309
BE20	19	2.187
C550	18	2.187
CRJ2	18	2.187
SF34	18	1.944
A319	16	1.944
B73Q	16	1.944
E145	16	1.701
C560	14	1.701
DC9	14	1.701
H25B	14	1.458
B737	12	1.458
CL60	12	1.458
F100	12	1.337
B190	11	1.215
B762	10	1.215
FA20	10	1.094
D328	9	1.094
E135	9	0.972
B735	8	0.972
BE40	8	0.972
BE9L	8	0.851
B734	7	0.851
B738	7	0.851
B763	7	0.729
C650	6	0.729
GLF4	6	0.729
LJ25	6	0.729
LJ35	6	0.608
B772	5	0.608
MD80	69	5.711

C501	5	0.608
C525	5	0.608
CARJ	5	0.608
DC10	5	0.608
DH8A	5	0.608
E120	5	0.608
JS41	5	0.608
LJ55	5	0.608
SBR1	5	0.486
A306	4	0.486
B350	4	0.486
BA46	4	0.486
BE36	4	0.486
F2TH	4	0.486
LJ60	4	0.486
MU30	4	0.486
PA31	4	0.365
B722	3	0.365
B744	3	0.365
BE58	3	0.365
C130	3	0.365
C182	3	0.365
C441	3	0.365
LJ24	3	0.365
LJ45	3	0.365
MD11	3	0.365
SW4	3	0.365
WW24	3	0.243
A340	2	0.243
AC90	2	0.243
ASTR	2	0.243
AT43	2	0.243
B58P	2	0.243
BE10	2	0.243
BE9T	2	0.243
C340	2	0.243
C414	2	0.243
C750	2	0.243
E110	2	0.243
FA10	2	0.243
GLF2	2	0.243
H25A	2	0.243

JS31	2	0.243
LJ31	2	0.243
LR31	2	0.243
P32R	2	0.243
PA46	2	0.122
A310	1	0.122
A330	1	0.122
AEST	1	0.122
B741	1	0.122
B742	1	0.122
BE30	1	0.122
BE35	1	0.122
BE55	1	0.122
BE8L	1	0.122
C17	1	0.122
C172	1	0.122
C208	1	0.122
C210	1	0.122
C303	1	0.122
C310	1	0.122
C421	1	0.122
C425	1	0.122
C500	1	0.122
DC87	1	0.122
DH8C	1	0.122
F70	1	0.122
FA50	1	0.122
FA90	1	0.122
GLF3	1	0.122
H25	1	0.122
J328	1	0.122
JS32	1	0.122
K35R	1	0.122
L101	1	0.122
L188	1	0.122
LH24	1	0.122
LR35	1	0.122
M20	1	0.122
MD90	1	0.122
MU2	1	0.122
P28A	1	0.122
PA27	1	0.122

PA28	1	0.122
PA34	1	0.122
PAY2	1	0.122
S601	1	0.122
SBR2	1	0.122
SW3	1	100.000
Total	823	100.000